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LOW-COST COUNTER ASSEMBLY FOR CURRENT-METER MEASUREMENTS

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ABSTRACT

A low-cost (under 35 dollars) counter assembly designed to replace earphones for current meter measurements is described. The simple, two-transistor circuit operates over at least a -20° to +40° C temperature range. The digital readout is helpful, especially at times of high stream velocities.

Keywords: Measurement systems (streamflow), current meter.

Prices for streamflow instrumentation indicate a considerable premium for accessories which free the operator from the tedium and potential inaccuracies of counting current-meter earphone signals. These accessories include electronic rate meters calibrated in terms of velocity, as well as recorders which display each contact closure. To meet a requirement of local Wenatchee National Forest personnel, several easily constructed, low-cost counters were fabricated to serve as current-meter readouts. The procedure of averaging over a period of time, either by counting pulses aurally or by accumulating pulses in some electro-mechanical device, was suggested as preferable to, or at least as acceptable as, an instantaneous meter reading, especially in small streams with substantial velocity fluctuations. Also, current meters with single contacts per rotation do not adapt well to electronic rate meter operation.

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The circuit in figure 1, adapted from Mitchell,[1] differs from most monostable circuits in that both transistors operate in unison; therefore, current drain (except for minor leakages) is a minimum when no pulse is received at the input. Counter assemblies operated satisfactorily over a temperature range of -20° to +40° C. Alkaline batteries are best for operation at low temperatures and long service life. Battery life obviously depends on condition of use; the C size battery should operate over 10 hours continuously at the highest counter rate, 20 counts per second. This is equivalent to about 600 1-minute counts. The circuit is easily constructed on a perforated circuit board; the printed circuit board shown in figure 3 was surplus from another device.

Figures 2 and 3 are photos of two views of a completed counter. The on-off switch is a momentary contact type requiring continuous pressure during the counting period. The second switch allows selection of a contact closure for each revolution of the rotor or of each fifth revolution as determined by the gearing inside the meter head. In most instances, this switch may be an unnecessary detail since the counter circuit is capable of counting pulses from each revolution up to the rated speed of most current meters. The stop watch is fixed to the counter panel by a nylon fastener,[2] placing all controls in easy view. The stop watch would not normally be reset; any equal time period would suffice for the counting period. For one-hand operation, a neck strap is advisable.

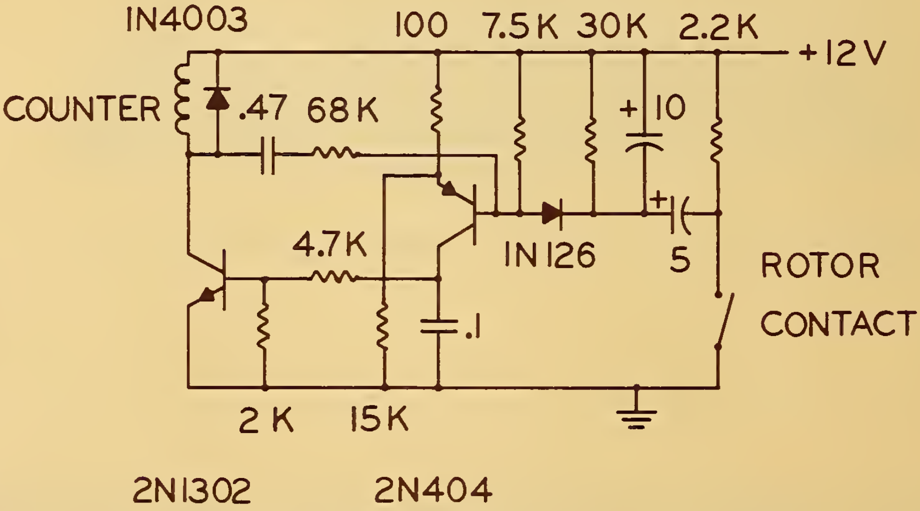

Figure 1.--Schematic of counter assembly.

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[1] W. P. Mitchell. Power one-shot. In *Sourcebook of Electronic Circuits*, (J. Markus, ed.), p. 432. McGraw-Hill, Inc., New York, 1968.

[2] Velcro® Hook and Loop Type Fastener. Mention of product by name does not imply endorsement by U.S. Department of Agriculture.

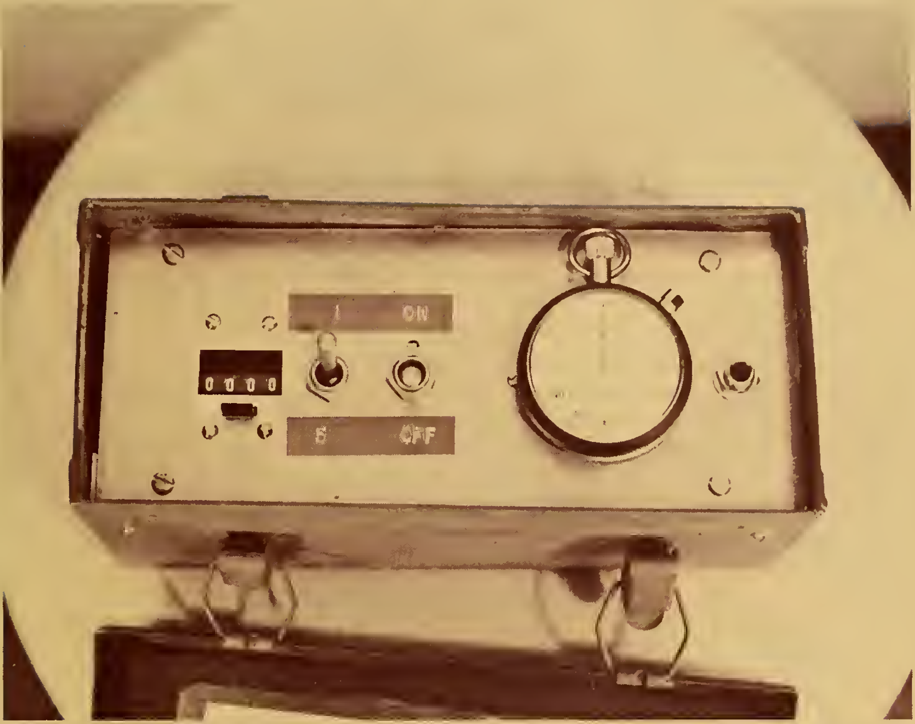

Figure 2.--Exterior view of completed counter assembly.

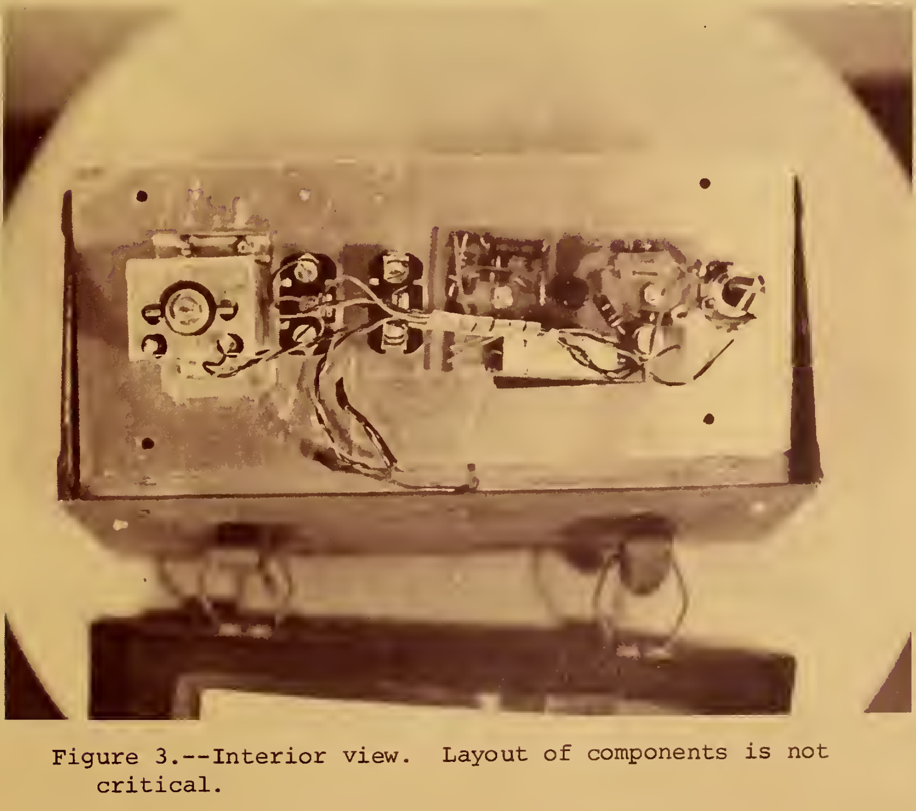

Figure 3.--Interior view. Layout of components is not critical.

Most current meters now in use probably do not have the newer sealed magnetic switches in the contacting mechanism. A variable resistance due to the water's conductivity is always across a nonsealed switch. Resistances parallel to the contacts as low as 2,000-3,000 ohms do not affect operation of the circuit. Expressed as conductivity, this is a value about 50 times greater than measured conductivities of our local stream. Contact noise can be a problem at the very lowest of rotor speeds (several counts per minute). At these low rotor speeds, the actual cup rotation is often visible (in clear streams) or the counter "chatter" used to signal a completed revolution. This "chatter" occurs because the circuit recognizes the poor contact as a series of separate events and reacts accordingly. Some filtering is provided by the large input capacitors to reduce contact noise. The large input capacitors cause the circuit to depart from true monostable action. "On" time of the circuit is determined, not by the coupling capacitor, as is customary, but by the charging of the input capacitors. For this application, however, the distinction is not important. For best results, especially at the lowest of rotor speeds, badly pitted or burned contacts should be replaced or refurbished. Further contact damage will be a minimum due to the small input current of this circuit.

Parts List

1. Resistors 10% ½ watt
2. Electrolytic capacitors - 15 volts minimum rating, observe polarity
3. .47; .1 capacitor - Mylar - 50V
4. Counter, 3 or 4 digit, push button reset, 12V DC, low current requirement, e.g., Hecon G856002-3 12DC

Electrically equivalent semiconductors may be substituted for devices listed. The counter is the most expensive circuit component, $15 to $25 depending on manufacturer. The Hecon unit lists for about $21. Total cost of other components should not exceed $12.

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